CLAIMS

WHAT IS CLAIMED IS:

1. A system for inspecting a borehole comprising:

a portable camera for generating images of at least a portion of an interior surface of the borehole and for generating signals representative of the generated images, said camera defining a viewing area adjacent the camera from which the images are generated;

a housing for the camera, said housing adapted to be lowered into the borehole;

a sensor for use with the housing for sensing a physical characteristic of the borehole; and

a computer receiving and responsive to the signals from the camera and the sensed physical characteristic for inspecting the borehole.

2. The system of claim 1 further comprising a light source for illuminating an area adjacent the camera within the defined viewing area thereby enabling the images of the interior surface of the borehole to be generated by the camera;

3. The system of claim 1 further comprising a monitor receiving and responsive to signals from the camera for displaying the images generated by the camera.

4. The system of claim 1 further comprising a video recorder for recording the images generated by the camera.

5. The system of claim 1 wherein the monitor comprises a computer having a display, said computer receiving the images generated by the camera and displaying the images on its display.

6. The system of claim 5 further comprising an image processor for acquiring an image of the interior surface of the borehole from the images generated by the camera and for processing the acquired image.

7. The system of claim 6 wherein the images generated by the camera each include a plurality of pixels, said pixels each having a value representative of an optical characteristic of the images, and wherein the image processor processes the acquired image of the interior surface of the borehole as a function of the pixel values.

8. The system of claim 1 further comprising a rechargeable power supply for supplying power to the camera.

9. The system of claim 1 further comprising a viewing envelope external to the housing and positioned adjacent the camera within the defined viewing area, said viewing envelope comprising a transparent shell defining a fluid chamber, said fluid chamber having a width substantially less than a width of a construction borehole under inspection.

10. The system of claim 1 wherein the viewing envelope comprises a transparent shell defining a fluid chamber.

11. The system of claim 1 wherein the sensor comprises one or more of the following: a penetrometer for quantifying a penetration on a bottom of the borehole; a thermocouple for measuring a temperature within the borehole; an electrical meter for measuring electrical conductivity of a slurry contained in the borehole, a pressure gauge for measuring a pressure exerted on the housing by the slurry; and a load cell for measuring a buoyant weight of the camera and housing in the slurry relative to a reference weight of the camera and housing in air.

12. The system of claim 11 wherein the penetrometer comprises a probe extending into the borehole from the housing, and wherein the quantified penetration is representative of an amount of a deposit at the bottom of the borehole.

13. The system of claim 12 wherein the probe comprises a graduated bar protruding from the housing and connected to the housing by a spring, said graduated bar being adapted for deflection when pressed against the bottom of the borehole and being within the viewing area of the camera.

14. The system of claim 1 further comprising a motion control mechanism connected to the portable camera for controlling a viewing angle of the portable camera relative to an axis of the housing and comprising a rotational motion stage for tilting the viewing angle in a plane relative to the axis of the housing.

15. The system of claim 1 further comprising a motion control mechanism connected to the portable camera for controlling a viewing angle of the portable camera relative to an axis of the housing and comprising a rotational motion stage for rotating the viewing angle about the axis of the housing.

16. A method of inspecting a borehole containing a slurry, said method comprising:

lowering a camera assembly into the slurry, said camera assembly having a reference weight in air;

determining a velocity at which the camera assembly is lowered;

measuring a buoyant weight of the camera assembly in the slurry;

determining a density of the slurry as a function of a comparison between the measured buoyant weight of the camera assembly in the slurry and the reference weight of the camera assembly in air.

17. A system for visually inspecting an interior surface of a construction borehole containing a slurry, said system comprising:

a camera assembly, said camera assembly comprising:

a portable camera for generating images of a portion of the interior surface of the borehole and for generating signals representative of the generated images;

a light source for illuminating an area adjacent the camera thereby enabling the images of the interior surface of the borehole to be generated by the camera;

a housing for the camera and the light source, said housing providing the camera with viewing access and adapted to be lowered into the borehole;

a viewing envelope positioned adjacent the camera and external to the housing, said viewing envelope comprising a transparent shell defining a fluid chamber and defining a viewing area adjacent the camera, said light source illuminating the viewing area, and said viewing envelope having a width substantially less than a width of the construction borehole; and

a load cell for measuring a buoyant weight of the camera assembly in the slurry relative to a reference weight of the camera assembly in air; and

a computer receiving and responsive to the measured buoyant weight for determining a density of the slurry in the borehole.

18. The system of claim 17 further comprising a video recorder for recording the images generated by the camera.

19. The system of claim 17 further comprising a monitor receiving and responsive to the signals from the camera for displaying the images generated by the camera.

20. The system of claim 17 further comprising an image processor for

acquiring an image of the interior surface of the borehole from the images generated by the camera and for processing the acquired image.

21. The system of claim 20 wherein the images generated by the camera each include a plurality of pixels, said pixels each having a value representative of an optical characteristic of the images, and wherein the image processor processes the acquired image of the interior surface of the borehole as a function of the pixel values.

22. The system of claim 17 further comprising a rechargeable power supply for supplying power to the camera and/or the monitor.

23. The system of claim 17 wherein the fluid chamber of the viewing envelope is filled with water.

24. The system of claim 17 wherein the transparent shell comprises a rigid plastic.

25. The system of claim 17 wherein the transparent shell comprises a flexible plastic.

26. The system of claim 17 further comprising a rotational motion stage for tilting the camera in a plane relative to an axis of the housing.

27. The system of claim 17 further comprising a rotational motion stage for rotating the camera about an axis of the housing.

28. The system of claim 17 further comprising a probe for use with the housing for measuring penetration on a bottom of the borehole and determining an amount of a deposit at the bottom of the borehole and wherein at least one of the

images generated by the camera displays the probe.

29. The system of claim 28 wherein the probe comprises a graduated bar protruding from the housing and connected to the housing by a spring, said graduated bar being in the viewing area of the camera.

30. The system of claim 17 wherein the housing includes a transparent dome through which the camera has viewing access.

31. The system of claim 17 wherein an outer width of the housing is substantially less than the width of the construction borehole.

32. The system of claim 17 wherein the fluid chamber of the viewing envelope is filled with air.

33. A system for visually inspecting an interior surface of a construction borehole, said system comprising:

a portable camera for generating images of a portion of the interior surface of the borehole and for generating signals representative of the generated images, said camera defining a viewing area adjacent the camera in which the images are generated;

a light source for illuminating at least a portion of the viewing area adjacent the camera thereby enabling the images of the interior surface of the borehole to be generated by the camera;

a housing for the camera and the light source, said housing adapted to be lowered into the borehole;

a probe for use with the housing for measuring a penetration of the probe on a bottom of the borehole and determining an amount of a deposit at the bottom of the borehole and wherein at least one of the images generated by the camera displays the probe; and

a monitor receiving and responsive to signals from the camera for displaying the images generated by the camera.

34. The system of claim 33 further comprising a video recorder for recording the images generated by the camera.

35. The system of claim 33 wherein the monitor comprises a computer having a display, said computer receiving the images generated by the camera and displaying the images on its display.

36. The system of claim 35 further comprising an image processor for acquiring an image of the interior surface of the borehole from the images generated by the camera and for processing the acquired image.

37. The system of claim 36 wherein the images generated by the camera each include a plurality of pixels, said pixels each having a value representative of an optical characteristic of the images, and wherein the image processor processes the acquired image of the interior surface of the borehole as a function of the pixel values.

38. The system of claim 33 further comprising a rechargeable power supply for supplying power to the camera and/or the monitor.

39. The system of claim 33 further comprising a viewing envelope positioned adjacent the camera, said viewing envelope defining a viewing area adjacent the camera, and wherein the light source illuminates the viewing area.

40. The system of claim 39 wherein the viewing envelope comprises a transparent shell defining a fluid chamber.

41. The system of claim 40 wherein the fluid chamber of the viewing envelope is filled with water.

42. The system of claim 40 wherein the transparent shell comprises a rigid plastic.

43. The system of claim 40 wherein the transparent shell comprises a flexible plastic.

44. The system of claim 33 further comprising a motion control mechanism connected to the portable camera for controlling a viewing angle of the portable camera relative to an axis of the housing and comprising a rotational motion stage for tilting the viewing angle in a plane relative to the axis of the housing.

45. The system of claim 33 further comprising a motion control mechanism connected to the portable camera for controlling a viewing angle of the portable camera relative to an axis of the housing and comprising a rotational motion stage for rotating the viewing angle about the axis of the housing.

46. The system of claim 33 wherein the probe comprises a graduated bar protruding from the housing and connected to the housing by a spring, said graduated bar being in the viewing area of the camera.